REINFORCING BAR COUPLER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates, in general, to reinforcing bar couplers and, more particularly, to a reinforcing bar coupler which is designed to couple reinforcing bars using a mechanical coupling method when the reinforcing bars are to be coupled to each other in reinforced concrete work, thus ensuring a prompt and easy coupling operation and allowing the reinforcing bars to be firmly coupled to each other.

2. Related Prior Art

There have been used various methods of jointing reinforcing bars; for example, a lap-joint process, a gas pressure welding process, a threaded-joint process, etc. Of these, the lap-joint process, which is carried out by overlapping the ends of the reinforcing bars for a certain length and binding them with binding wires, is predominantly used. However, the lap-joint process has a disadvantage in that the lapped reinforcing bars are weak in resistance to a tensile load. The gas pressure welding process is carried out by butting together the ends of the reinforcing bars and welding them to each other through oxy acetylene welding. However, the gas welding process is problematic in that it is complicated and

takes a longer time to execute. Further, the welded portion of the reinforcing bars is weakened by heat, and a post inspection is further required. The threaded-joint process is carried out as follows: A male thread is formed on each end of each reinforcing bar. The ends of the reinforcing bars are coupled to each other by a coupler having an internal female thread on both ends. However, the threaded-joint process has a problem in that the ends of the reinforcing bars must be threaded and the long reinforcing bars must be coupled to each other with a screw-type motion while remaining aligned with each other, so that it is difficult to execute the threaded-joint process. The threaded-joint process has another problem in that the threaded end of each reinforcing bar has a smaller diameter compared to the majority of the reinforcing bar, so that the threaded end is weakened in resistance to a tensile load.

SUMMARY OF THE INVENTION

Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a mechanical reinforcing bar coupler which includes a base sleeve, a cover sleeve, and a wedge, so that reinforcing bars are coupled to each other merely by fitting the wedge into the sleeve using a simple hammering tool or a hydraulic tool, thus ensuring a prompt and easy coupling operation, and allowing the reinforcing bars to be firmly coupled to each other. Further, the base sleeve is axially open at a surface thereof to form an opening, so that a worker executes the

coupling operation while observing the interior of the base sleeve with the naked eye; thus the coupling operation is more promptly and conveniently carried out. Further, it is possible to fabricate components of the reinforcing bar coupler from steel plate using a press, thus allowing mass production of the reinforcing bar coupler and thereby considerably reducing the cost of the reinforcing bar coupler.

Another object of the present invention is to provide a mechanical reinforcing bar coupler which allows the reinforcing bars to be coupled to each other while being lapped, thus affording a prompt and convenient coupling operation, providing a joint with a higher resistance to a tensile or compressive load compared to a lap-joint process using binding wires, and allowing the length of lapped regions of the reinforcing bars to be shorter and thereby increasing distances between adjacent coupled reinforcing bars, therefore allowing the concrete pouring operation to be easily executed.

A further object of the present invention is to provide a reinforcing bar coupler which allows elements of the reinforcing bar coupler to be manufactured without an additional process, such as a threading process, thus reducing manufacturing costs of the reinforcing bar coupler.

Still another object of the present invention is to provide a reinforcing bar coupler capable of coupling reinforcing bars which may have a small difference in the size of the reinforcing bars according to manufacturing companies in spite of the same standard, as long as the reinforcing bars have semi-annular ribs of the same shape, and regardless of whether the semi-annular ribs of the reinforcing bars have a circular or semicircular shape. In order to accomplish the above

objects, the present invention provides a reinforcing bar coupler including a cylindrical base sleeve which is open at a surface thereof, and has a first seating groove axially provided in the base sleeve so that the ends of the reinforcing bars are seated therein, and a pair of first locking parts each having a first slanted surface, and including a cover sleeve which has a second seating groove axially provided in the cover sleeve to cover the reinforcing bars seated in the first seating groove of the base sleeve, and including a wedge which has a pair of second locking parts each having a second slanted surface. In this case, the wedge is axially fitted into the base sleeve to be placed between the first locking parts of the base sleeve and the cover sleeve, so that the wedge wedges the cover sleeve and the reinforcing bars into the base sleeve, thus allowing the reinforcing bars to be firmly coupled to each other.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an exploded perspective view of a reinforcing bar coupler, according to a first embodiment of the present invention;

FIG. 2 is a side view of the reinforcing bar coupler of FIG. 1, in which two reinforcing bars are coupled to each other by the reinforcing bar coupler;

FIG. 3 is a sectional view taken along the line C-C of FIG. 2;

FIG. 4 is a sectional view taken along the line D-D of FIG. 2;

FIG. 5 is a perspective view of the reinforcing bar coupler of FIG. 1, when the reinforcing bars are coupled to each other by the reinforcing bar coupler;

FIG. 6 is a sectional view taken along the line C-C of FIG. 2 showing a reinforcing bar coupler according to a modification of the first embodiment, in which the reinforcing bar coupler includes an additional rib seat between the semi-annular grooves of a base sleeve, and an additional rib seat between the semi-annular grooves of a cover sleeve;

FIG. 7 is an exploded perspective view of a reinforcing bar coupler, according to a second embodiment of the present invention;

FIG. 8 is a perspective view of a wedge included in the reinforcing bar coupler of FIG. 7;

FIG. 9 is a side view of the reinforcing bar coupler of FIG. 7 when shown from a leading end of the wedge, in which two reinforcing bars are coupled to each other by the reinforcing bar coupler;

FIG. 10 is a sectional view taken along the line E-E of FIG. 9;

FIG. 11 is a perspective view of the reinforcing bar coupler of FIG. 7, when the reinforcing bars are coupled to each other by the reinforcing bar coupler;

FIG. 12 is a perspective view of the reinforcing bar coupler of FIG. 7, when the reinforcing bars are coupled to each other by a plurality of reinforcing bar couplers;

FIG. 13 is a side view of a reinforcing bar coupler according to a modification of the second embodiment, in which locking parts of a base sleeve

and locking parts of a cover sleeve extend outward, different from the reinforcing bar coupler of FIG. 7;

FIG. 14 is an exploded perspective view of a reinforcing bar coupler, according to a third embodiment of the present invention;

FIG. 15 is a perspective view of a wedge included in the reinforcing bar coupler of FIG. 14;

FIG. 16 is a perspective view of a wedge included in a reinforcing bar coupler according to a modification of the third embodiment, in which the wedge has a shape different from the wedge of FIG. 15;

FIG. 17 is a side view of the reinforcing bar coupler of FIG. 14 when shown from a hammering end of the wedge, in which two reinforcing bars are coupled to each other by the reinforcing bar coupler;

FIG. 18 is a sectional view taken along the line G-G of FIG. 17;

FIG. 19 is a sectional view taken along the line H-H of FIG. 17;

FIG. 20 is an exploded perspective view of a reinforcing bar coupler, according to a fourth embodiment of the present invention;

FIG. 21 is a side view of the reinforcing bar coupler of FIG. 20, when the reinforcing bars are coupled to each other by the reinforcing bar coupler;

FIG. 22 is a sectional view taken along the line A-A of FIG. 21;

FIG. 23 is a perspective view of the reinforcing bar coupler of FIG. 20, when the reinforcing bars are coupled to each other by the reinforcing bar coupler;

FIG. 24 is a sectional view taken along the line A-A of FIG. 21 showing a reinforcing bar coupler according to a modification of the fourth embodiment, in

which the reinforcing bar coupler is used to couple deformed bars having semicircular ribs to each other;

FIG. 25 is an exploded perspective view of a reinforcing bar coupler, according to a fifth embodiment of the present invention;

FIG. 26 is a side view of the reinforcing bar coupler of FIG. 25, when two reinforcing bars are coupled to each other by the reinforcing bar coupler;

FIG. 27 is a sectional view taken along the line B-B of FIG. 26;

FIG. 28 is a perspective view of the reinforcing bar coupler of FIG. 25, when the reinforcing bars are coupled to each other by the reinforcing bar coupler;

FIG. 29 is a sectional view taken along the line B-B of FIG. 26 showing a reinforcing bar coupler according to a first modification of the fifth embodiment, in which the reinforcing bar coupler is used to couple deformed bars having semicircular ribs to each other;

FIG. 30 is a sectional view taken along the line B-B of FIG. 26 showing a reinforcing bar coupler according to a second modification of the fifth embodiment, in which the reinforcing bar coupler is used to couple deformed bars having semicircular ribs to each other;

FIG. 31 is an exploded perspective view of a reinforcing bar coupler, according to a sixth embodiment of the present invention;

FIG. 32 is a perspective view of a wedge included in the reinforcing bar coupler of FIG. 31;

FIG. 33 is a perspective view of a wedge included in a reinforcing bar coupler according to a modification of the sixth embodiment, in which the wedge

has a shape different from that of the wedge of FIG. 32;

FIG. 34 is a side view of the reinforcing bar coupler of FIG. 31 when shown from a hammering end of the wedge, in which two reinforcing bars are coupled to each other by the reinforcing bar coupler; and

FIG. 35 is a sectional view taken along the line F-F of FIG. 34.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference should now be made to the drawings, in which the same reference numerals are used throughout the different drawings to designate the same or similar components.

FIGS. 1 through 6 show a reinforcing bar coupler according to the first embodiment of the present invention. According to the first embodiment, first and second reinforcing bars 1 and 1a are coupled to each other so that the ends of the first and second reinforcing bars 1 and 1a are lapped together, using a base sleeve 2 which is open at a surface thereof, a cover sleeve 3, and a single wedge 4.

The base sleeve 2 has the shape of a cylinder which is axially open at a surface thereof to form an opening 23. A pair of seating ridges 24 is axially provided in the base sleeve 2, arranged side by side so that the ends of the first and second reinforcing bars 1 and 1a are seated side by side in the seating ridges 24. Each of the seating ridges 24 has a semicircular cross-section and a depth corresponding to about a half of a diameter of each of the first and second

reinforcing bars 1 and 1a. A plurality of semi-annular grooves 26 having a semicircular cross-section are provided on predetermined portions of the seating ridges 24 to allow semi-annular ribs 12 of each of the first and second reinforcing bars 1 and 1a to be seated therein.

Both sidewalls 25 of the base sleeve 2 extend upward from the outer edges of the seating ridges 24 facing each other. The distance between the sidewalls 25 is slightly longer than the distance between outside longitudinal ribs 11 of the first and second reinforcing bars 1 and 1a which are seated in the seating ridges 24, thus allowing the cover sleeve 3 to be easily seated in the base sleeve 2.

Further, the base sleeve 2 includes a pair of locking parts 27 to be locked to locking parts 45 of the wedge 4 which will be described later herein. Each of the locking parts 27 extends perpendicularly from the upper edge of the associated sidewall 25 to form a U-shaped cross-section. In this case, the locking parts 27 are not connected to each other, and a slanted surface 29 is axially formed along an inner surface of each of the locking parts 27 to be in contact with an associated slanted surface 46 of the wedge 4 described later herein.

On an outer surface of the base sleeve 2 are provided a plurality of semi-annular ribs 22 and longitudinal ribs 21 having the same shapes as the semi-annular ribs 12 and longitudinal ribs 11 of the first and second reinforcing bars 1 and 1a, thus increasing the adhesive force between the first and second reinforcing bars 1 and 1a and the concrete.

The cover sleeve 3 is longer than the base sleeve 2 by about a half of an

interval between the semi-annular ribs 12 of each of the first and second reinforcing bars 1 and 1a. Further, the cover sleeve 3 is slightly narrower than the interval between the sidewalls 25 which upwardly extend from the outer edges of the seating ridges 24 to face each other, so that the cover sleeve 3 is easily seated in the space between the sidewalls 25 of the base sleeve 2.

The cover sleeve 3 has, at a surface thereof, a pair of seating ridges 31 which are arranged side by side to correspond to the seating ridges 24 of the base sleeve 2, thus covering and compressing the outer surfaces of the first and second reinforcing bars 1 and 1a seated in the seating ridges 24. A flat surface 33 is formed at a side opposite to the seating ridges 31. Further, a serrated surface 33a is formed on a predetermined portion of the flat surface 33 to engage with a serrated surface 43a of the wedge 4, thus preventing the wedge 4 from being removed from the base sleeve 2 after the first and second reinforcing bars 1 and 1a are coupled to each other.

Further, a plurality of semi-annular grooves 32 are formed on the seating ridges 31 of the cover sleeve 3 to have the same shape as the semi-annular grooves 26 of the base sleeve 2.

The wedge 4 is slightly longer than the cover sleeve 3 in length, while being equal to the cover sleeve 3 in width. The wedge 4 includes a flat surface 43 which is in contact with the flat surface 33 of the cover sleeve 3. The serrated surface 43a is formed on a predetermined portion of the flat surface 43 to engage with the serrated surface 33a of the cover sleeve 3. More than one groove 44 are axially formed along the flat surface 43 to reduce the surface area contacting the

flat surface 33 of the cover sleeve 3, thus allowing the wedge 4 to be easily fitted into the base sleeve 2 in such a way as to be placed between the cover sleeve 33 and the locking parts 27 of the base sleeve 2. A flat middle section 47 is formed on a side opposite to the flat surface 43 of the wedge 4. A pair of locking parts 45 extends from opposite sides of the middle section 47 to form a U-shaped cross-section, thus engaging with the locking parts 27 of the base sleeve 2. A slanted surface 46 is axially formed along an outer surface of each of the locking parts 45 tapering in a direction from a first end to a second end of each of the locking parts 45, thus being in close contact with the slanted surface 29 of each of the locking parts 27 of the base sleeve 2.

The operation of the reinforcing bar coupler according to the first embodiment will be described below in detail.

First, the first and second reinforcing bars 1 and 1a are placed so that the ends of the first and second reinforcing bars 1 and 1a overlap by a certain distance. A worker holds and moves the base sleeve 2 to receive the lapped ends of the first and second reinforcing bars 1 and 1a in the opening 23 of the base sleeve 2. The first and second reinforcing bars 1 and 1a are seated in the seating ridges 24 of the base sleeve 2. Next, the cover sleeve 3 is axially fitted into the base sleeve 2 from an end of the base sleeve 2 to cover the first and second reinforcing bars 1 and 1a. Thereafter, a leading end 41 of the wedge 4 is inserted into a space between the flat surface 33 of the cover sleeve 3 and the locking parts 27 of the base sleeve 2, and then a hammering end 42 of the wedge 4 is hammered using a tool, such as a hammer or a hydraulic jack. While the

wedge 4 is fitted into the base sleeve 2, the slanted surfaces 29 of the locking parts 27 of the base sleeve 2 are in close contact with the slanted surfaces 46 of the locking parts 45 of the wedge 4, so that the wedge 4 compresses the cover sleeve 3 and the cover sleeve 3 strongly compresses the outer surfaces of the first and second reinforcing bars 1 and 1a, thus allowing the first and second reinforcing bars 1 and 1a to be firmly coupled to each other.

The reinforcing bar coupler, which couples reinforcing bars to each other in a lap-joint process, is mainly used to couple reinforcing bars having a relatively small diameter. But, such a reinforcing bar coupler may also be used to couple reinforcing bars having a larger diameter during the arrangement of bars. The reinforcing bar coupler of this invention is equal to a conventional reinforcing bar coupler, in that reinforcing bars are coupled to each other while the ends of the reinforcing bars are overlapped by a certain distance. However, according to the present invention, the reinforcing bars are coupled to each other by the mechanical reinforcing bar coupler having the base sleeve 2, the cover sleeve 3, and the wedge 4, as opposed to the conventional reinforcing bar coupler using binding wires. Thus, the reinforcing bar coupler of this invention allows the coupling operation to be easily executed, thus reducing the time required. Further, the reinforcing bar coupler of this invention allows the overlap length of the coupled reinforcing bars to be reduced, thus reducing building costs. Since distances between adjacent coupled reinforcing bars are increased when the coupled reinforcing bars are arranged, it is possible to thickly, deeply, and evenly pour concrete into a mold fabricated with concrete molding panels, thus increasing

the strength of a reinforced concrete structure. Further, the reinforcing bar coupler of this invention allows the coupled part of the reinforcing bars to have a higher resistance to tensile or compressive load, compared to the conventional reinforcing bar coupler which couples the reinforcing bars with binding wires.

FIG. 6 shows a reinforcing bar coupler, according to a modification of the first embodiment. Additional semi-annular grooves 26 are provided between the semi-annular grooves 26 of the seating ridges 24 of the base sleeve 2, and additional semi-annular grooves 32 are provided between the semi-annular grooves 32 of the seating ridges 31 of the cover sleeve 3, thus allowing the semi-annular ribs 12 to be seated in the semi-annular grooves 26 and 32, regardless of whether the shape of the semi-annular ribs 12 is circular or semicircular. In a detailed description, when the first and second reinforcing bars 1 and 1a are coupled to each other while the ends of the reinforcing bars 1 and 1a are lapped, the semi-annular ribs 12 of the first and second reinforcing bars 1 and 1a must be simultaneously seated in the semi-annular grooves 26 of the base sleeve 2 and the semi-annular grooves 32 of the cover sleeve 3. In this case, the first and second reinforcing bars 1 and 1a may have the semi-annular ribs 12 of the same shape, such as a circular or semicircular shape, but one of the reinforcing bars 1 and 1a may have semi-annular ribs 12 of a circular shape while the other reinforcing bar 1, 1a may have semi-annular ribs 12 of a semicircular shape. However, the additional semi-annular grooves 26, 32 are provided between the semi-annular grooves 26, 32, thus allowing the semi-annular ribs 12 of the reinforcing bars 1 and 1a to be simultaneously seated in the semi-annular grooves

26 and 32.

FIGS. 7 through 13 show a reinforcing bar coupler according to the second embodiment of the present invention. The reinforcing bar coupler of the second embodiment is equal to that of the first embodiment, except that the first and second reinforcing bars 1 and 1a are coupled to each other by fitting only a wedge 4a into a base sleeve 2a without using the cover sleeve 3.

The base sleeve 2a has the same construction as that of the first embodiment. Further, additional semi-annular grooves 26 may be provided between the semi-annular grooves 26 of the seating ridges 24 of the base sleeve 2a so as to receive the first and second reinforcing bars 1 and 1a having semi-annular ribs 12 of various shapes, as shown in FIG. 6.

The wedge 4a has the same width and length as the wedge 4 of the first embodiment. But, according to the second embodiment, since the first and second reinforcing bars 1 and 1a are wedged into the base sleeve 2a by only the wedge 4a without the cover sleeve 3, the wedge 4a is formed to be thicker than the wedge 4, thus allowing the outer surfaces of the first and second reinforcing bars 1 and 1a to be sufficiently compressed.

A leading end 41 of the wedge 4a is chamfered so that the wedge 4a smoothly slides into the base sleeve 2a while not being hindered by the outer surfaces or the semi-annular ribs 12 of the first and second reinforcing bars 1 and 1a, when the wedge 4a is hammered into the base sleeve 2a in which the first and second reinforcing bars 1 and 1a are seated. A serrated surface 43a is formed throughout a flat surface 43 contacting the first and second reinforcing bars 1 and

1a to directly compress the outer surfaces of the first and second reinforcing bars 1 and 1a. Further, as shown in FIG. 8, a projecting part having a cross-section of a right triangle is provided at a hammering end 42 of a middle section 47 of the wedge 4a so that the wedge 4a is not hindered by the outer surfaces of the first and second reinforcing bars 1 and 1a when the wedge 4a is hammered into the base sleeve 2a.

FIG. 13 shows a reinforcing bar coupler according to a modification of the second embodiment. The reinforcing bar coupler of FIG. 13 is the same as that of the second embodiment, except for the cross-sections of locking parts 27 of the base sleeve 2a and locking parts 45 of the wedge 4a. In the reinforcing bar coupler of FIG. 13, the locking parts 27 of the base sleeve 2a extend outwards from the upper edges of the sidewalls 25 to be perpendicular to the sidewalls 25. A slanted surface 29 is formed along the lower surface of each of the locking parts 27 to be slanted upward in a direction from an outside edge to an inside edge of the lower surface of each locking part 27. The locking parts 45 of the wedge 4a extend outward from opposite sides of the middle section 47 and are bent downward, prior to being bent toward the serrated surface 43a to form a U-shaped cross-section. A slanted surface 46 is formed along the upper surface of the inward extending part of each of the locking parts 45 to correspond to the slanted surfaces 29 of the base sleeve 2a. The general construction and operation of the reinforcing bar coupler of FIG. 13 remain the same as those of the reinforcing bar coupler of the second embodiment.

The coupling method using the reinforcing bar coupler according to the

second embodiment is as follows.

First, the first and second reinforcing bars 1 and 1a are seated side by side in the seating ridges 24 of the base sleeve 2a while the ends of the first and second reinforcing bars 1 and 1a are overlapped by a certain distance. Next, the wedge 4a is loosely inserted into the base sleeve 2a and placed between the first and second reinforcing bars 1 and 1a seated in the base sleeve 2a and the locking parts 27, and then is hammered using a hammering tool. At this time, the slanted surfaces 29 of the base sleeve 2a come into close contact with the slanted surfaces 46 of the wedge 4a so that the serrated surface 43a of the wedge 4a strongly compresses the outer surfaces of the first and second reinforcing bars 1 and 1a, thus allowing the first and second reinforcing bars 1 and 1a to be firmly coupled to each other.

The reinforcing bar coupler of the second embodiment may be used to couple reinforcing bars to each other while the ends of the reinforcing bars are overlapped, in place of binding wires. The reinforcing bar coupler of the second embodiment has more convenient operation and allows the reinforcing bars to be more firmly coupled to each other in comparison with the coupling operation using binding wires. Further, one or more reinforcing bar couplers may be installed on the overlapped portions of the reinforcing bars, as shown in FIG. 12. As such, the number of the reinforcing bar couplers may be adjusted as desired.

FIGS. 14 through 19 show a reinforcing bar coupler according to the third embodiment of the present invention. The reinforcing bar coupler of the third embodiment has the same construction and elements as the first embodiment,

except that the base sleeve 2b and the wedge 4b are both manufactured to have a constant thickness by plastically deforming a steel plate of a predetermined thickness using a pressing machine. Accordingly, the entire portion of the base sleeve 2b has a constant thickness, and semicircular projecting ribs are formed on the outer surfaces of the seating ridges 24 of the base sleeve 2b at positions corresponding to the semi-annular grooves 26 of the seating ridges 24, thus serving as the semi-annular ribs 24 of the base sleeve 2, 2a. Further, the wedge 4b is manufactured by plastically deforming a steel plate using the pressing machine, so that the entire portion of the wedge 4b has a constant thickness. In order to prevent the wedge 4b from being removed from its position between a cover sleeve 3b and locking parts 27 of the base sleeve 2b, a serrated surface 43a is formed on a predetermined portion of a flat surface 43. Or, an inner surface of each of the locking parts 27 is formed to have a width which is slightly smaller than the width of each of the locking parts 45 of the wedge 4b, so that the portions of the locking parts 45 adjacent to the leading end 41 are securely locked to the locking parts 27 of the base sleeve 2b, thus preventing the wedge 4b from being removed from the base sleeve 2b. As shown in FIG. 15, a hammering end 42 of a middle section 47 of the wedge 4b projects away from the flat surface 43, thus forming a V-shaped projecting part. The V-shaped projection allows the hammering area of the wedge 4b to be increased, thus allowing the wedge 4b to be easily hammered without being hindered by the first and second reinforcing bars 1 and 1a. Further, a steel plate of a constant thickness is cut to have a trapezoidal shape, and then is bent upwards at both side edges thereof with a

pressing machine to form the locking parts 45 of the wedge 4b. A slanted surface 46 is formed along each of the locking parts 45 in such a way that the height of the slanted surface 46 is tapered from a first end to a second end of each of the locking parts 45. As shown in FIG. 16, a groove 44 having a V-shaped cross-section is axially formed along the middle section 47 of the wedge 4b, so as to reduce the surface area contacting with the cover sleeve 3b.

The coupling method using the reinforcing bar coupler according to the third embodiment remains the same as the first embodiment.

In the reinforcing bar coupler of the third embodiment, the base sleeve 2b is open at a surface. Therefore, it is possible to manufacture the base sleeve 2b by forming a steel plate using the pressing machine, thus accomplishing mass production of the reinforcing bar coupler and thereby considerably reducing the cost of the reinforcing bar coupler.

FIGS. 20 through 24 show a reinforcing bar coupler according to the fourth embodiment of the present invention. The reinforcing bar coupler of the fourth embodiment couples the first and second reinforcing bars 1 and 1a in a row without lapping the ends of the reinforcing bars 1 and 1a. The reinforcing bar coupler includes a base sleeve 2c open at a surface thereof, a cover sleeve 3c, and a pair of wedges 4c. The general construction and operation of the reinforcing bar coupler of the fourth embodiment remain the same as the first embodiment, except that the first and second reinforcing bars 1 and 1a are coupled in a row. Thus, the reinforcing bar coupler of the fourth embodiment is constructed as follows. A single seating groove 24 is provided along an inner

surface of the base sleeve 2c, and a single seating ridge 31 is provided along a surface of the cover sleeve 3c, and the wedge 4c comprises a pair of wedges 4c.

Slanted surfaces 29 of the locking parts 27 of the base sleeve 2c are formed to have a diameter which increases in a direction from a central portion to opposite ends of the base sleeve 2c so that the pair of wedges 4c are fitted into the base sleeve 2c from the opposite ends having the enlarged diameter. Since the first and second reinforcing bars 1 and 1a are coupled in a row, the first and second reinforcing bars 1 and 1a are axially fitted into the base sleeve 2c so that the leading ends of the reinforcing bars 1 and 1a reach central portions of both the seating groove 24 of the base sleeve 2c and the seating ridges 31 of the cover sleeve 3c. On the central portions of the seating ridges 24 and 31 are provided space 28 and 34, respectively. Each of the space 28 and 34 has a width corresponding to a width between three semi-annular ribs 12 and is slightly deeper than the associated rib seat 26, 32. Therefore, in case the leading ends of the first and second reinforcing bars 1 and 1a are bent during a cutting process using a pressing machine or there exist projecting parts which have larger diameters than the first and second reinforcing bars 1 and 1a, the space 28 and 34 allow the bent leading ends or the projecting parts to be completely received therein, thus allowing the semi-annular ribs 12 of the first and second reinforcing bars 1 and 1a to be completely seated in the base sleeve 2c and the cover sleeve 3c.

A pair of serrated surfaces 33a is formed on opposite ends of a flat surface 33 of the cover sleeve 3c. The wedge 4c comprises a pair of wedges 4c,

and has a length corresponding to about a half of the length of the base sleeve 2c. A serrated surface 43a is formed on one end of a flat surface 43 of each of the wedges 4c.

FIG. 24 shows a reinforcing bar coupler according to a modification of the fourth embodiment. The reinforcing bar coupler of FIG. 24 is used to couple deformed bars 1 and 1a which are designed so that semi-annular ribs 12 thereof are staggered with respect to associated longitudinal ribs 11, without the necessity of using a cover sleeve different from the cover sleeve 3c. The reinforcing bar coupler of FIG. 24 may be applied to couple the deformed bars 1 and 1a to each other, regardless of whether the semi-annular ribs 12 of each of the deformed bars 1 and 1a have a circular or semicircular shape. In order to allow the deformed bars 1 and 1a to be coupled to each other using a single kind of reinforcing bar coupler, the cover sleeve 3c is manufactured to have a length which is longer than the base sleeve 2c by about a half of the interval between the semi-annular grooves 32. Further, outside semi-annular grooves 32 are provided at opposite ends of the cover sleeve 31, thus allowing semi-annular ribs 12 of all shapes to be seated in the semi-annular grooves 32. Further, the flat surface 33 of the cover sleeve 3c is formed to be flat while not being slanted, and the flat surface 43 of each wedge 4c is also formed to be flat. Thus, when the cover sleeve 3c is fitted into the base sleeve 2c, the position of the cover sleeve 3c may be adjusted so that the cover sleeve 3c projects axially from an end of the base sleeve 2c by about a half of one interval between the semi-annular ribs 12. In this case, the pair of wedges 4c are respectively inserted into the base sleeve 2c from

opposite ends of the base sleeve 2c and placed between the cover sleeve 3c and the locking parts 27 of the base sleeve 2c. At this time, the pair of wedges 4c is inserted from the opposite ends of the base sleeve 2c to the same depth. Thus, the wedges 4c evenly wedge the entire portion of the flat surface 33 of the cover sleeve 3c, so that the cover sleeve 3c sufficiently compresses the outer surfaces of the first and second deformed bars 1 and 1a seated in the base sleeve 2c. Thereby, the first and second deformed bars 1 and 1a are firmly coupled to each other. Further, the deformed bars 1 and 1a, which have the same standard thickness but have semi-annular ribs 12 of different shapes, can be coupled to each other by the reinforcing bar coupler having a single kind of cover sleeve 3c, so that it is unnecessary to prepare different cover sleeves according to the shapes of the semi-annular ribs 12 of the first and second deformed bars 1 and 1a, thus causing convenience for a worker, allowing elements of the reinforcing bar coupler to be easily managed, and allowing the coupling operation to be conveniently carried out.

Although reinforcing bars have the same standard, there may exist a small difference in the size of the reinforcing bars according to manufacturing companies. However, the reinforcing bar coupler of the fourth embodiment allows the insertion depth of each of the wedges 4c to be adjusted according to the thickness of each of the reinforcing bars, thus allowing the reinforcing bars to be firmly coupled to each other and thereby overcoming problems of the conventional reinforcing bar coupler using the cover sleeve.

The operation of the reinforcing bar coupler according to the fourth

embodiment will be described in the following in detail.

The first reinforcing bar 1 is fitted into the base sleeve 2c while the worker confirms that the leading end of the first reinforcing bar 1 reaches the depression 28 of the base sleeve 2c. At this time, the position of the first reinforcing bar 1 is adjusted so that the semi-annular ribs 12 of the first reinforcing bar 1 are seated in the semi-annular grooves 26 of the seating groove 24. Next, the second reinforcing bar 1a is fitted into the base sleeve 2c in the same manner as the first reinforcing bar 1. Thereafter, the cover sleeve 3c is axially fitted into a space between the sidewalls 25 of the base sleeve 2c from an end of the base sleeve 2c in such a way that the semi-annular ribs 12 of the first and second reinforcing bars 1 and 1a are seated in the semi-annular grooves 32 while an end of the cover sleeve 3c projects slightly from the base sleeve 2c or is flush with the end of the base sleeve 2c. Subsequently, the leading ends 41 of the pair of wedges 4c are aligned with the opposite ends of the base sleeve 2c, and then the wedges 4c are fitted into the base sleeve 2c from the opposite ends of the base sleeve 2c using a hammering tool or a hydraulic tool so that the locking parts 45 of the wedge 4c are securely locked to the locking parts 27 of the base sleeve 2c. At this time, the slanted surfaces 29 of the locking parts 27 of the base sleeve 2c are in close contact with the slanted surfaces 46 of the locking parts 45 of the wedge 4c, strongly compressing the cover sleeve 3c toward the outer surfaces of the first and second reinforcing bars 1 and 1a, so that the first and second reinforcing bars 1 and 1a are firmly coupled to each other. Further, the serrated surfaces 33a of the cover sleeve 3c engage with the serrated surfaces 43a of the pair of wedges

4c, respectively, thus preventing the wedges 4c from being removed from the base sleeve 2c.

In the reinforcing bar coupler according to the fourth embodiment, wherein the pair of wedges 4c are fitted into the base sleeve 2c from opposite ends of the base sleeve 2c, each of the wedges 4c has a length corresponding to about a half of a length of the base sleeve 2c. When it is assumed that the slanted surface of the fourth embodiment has the same slant angle as a slanted surface of the fifth embodiment which will be described hereinafter, the thickness of the hammering end 42 of each locking part 45 may be thinner and the insertion depth of each wedge 4c into the base sleeve 2c may be shorter compared to the fifth embodiment, where a length of a wedge 4d is almost equal to that of the cover sleeve 3d. Thus, the reinforcing bar coupler of the fourth embodiment allows the hammering operation to be easily carried out. Further, the reinforcing bar coupler of the fourth embodiment is suitable for coupling thick reinforcing bars to each other.

FIGS. 25 through 30 show a reinforcing bar coupler according to the fifth embodiment of the present invention. The general construction of the reinforcing bar coupler of the fifth embodiment remains the same as that of the fourth embodiment. The reinforcing bar coupler of the fifth embodiment couples first and second reinforcing bars 1 and 1a to each other using a base sleeve 2d open at a surface thereof, a cover sleeve 3d, and a single wedge 4d. In the reinforcing bar coupler of the fifth embodiment, a slanted surface 29 of each of the locking parts 27 of the base sleeve 2d has a constant slant angle from a first end to a second

end of each of the locking parts 27, different from the reinforcing bar coupler of the fourth embodiment where the slanted surfaces 29 are formed to have a diameter which increases in a direction from a central portion to the opposite ends of the base sleeve 2c. However, the general construction of the cover sleeve 3d remains the same as that of the cover sleeve 3c of the fourth embodiment, except that a serrated surface 33a is formed on an end of a flat surface 33. According to the fifth embodiment, the wedge 4d comprises a single wedge having a length which is almost equal to the cover sleeve 3d, and a slanted surface 46 of each of the locking parts 45 has a constant slant angle from a first end to a second end of each of the locking parts 45 so as to correspond to the slanted surface 29 of the base sleeve 2d. Therefore, as the wedge 4d is fitted into the base sleeve 2d, the cover sleeve 3d compresses the outer surfaces of the first and second reinforcing bars 1 and 1a.

The reinforcing bar coupler having only a single wedge 4d is applied to a case where each of the first and second reinforcing bars 1 and 1a has a relatively small diameter. As such, in a case where each of the first and second reinforcing bars 1 and 1a has a relatively small diameter, a long base sleeve 2d is not required, different from the base sleeve 2c of the fourth embodiment. Thus, the first and second reinforcing bars 1 and 1a having a smaller diameter may be coupled to each other using only a single wedge 4d, without the necessity of inserting a pair of wedges into the base sleeve from opposite ends of the base sleeve. The smaller the diameter of each of the first and second reinforcing bars 1 and 1a, the shorter the length of the base sleeve 2d. The reinforcing bar

coupler of the fifth embodiment needs only a single wedge 4d, thus reducing the number of elements.

FIGS. 29 and 30 show a reinforcing bar coupler according a modification of the fifth embodiment. The reinforcing bar coupler is used to couple deformed bars 1 and 1a which are designed so that semi-annular ribs 12 thereof are staggered with respect to the associated longitudinal ribs 11, using a single kind of cover sleeve 3d. The reinforcing bar coupler may be applied to couple the deformed bars 1 and 1a to each other, regardless of whether the semi-annular ribs 12 of the deformed bars 1 and 1a have a circular or semicircular shape. The reinforcing bar coupler allows the deformed bars 1 and 1a to be coupled to each other using a single kind of reinforcing bar coupler 3d. The operational principle of the reinforcing bar coupler remains the same as that of FIG. 24.

The operation and coupling sequence of the reinforcing bar coupler according to the fifth embodiment remain the same as the fourth embodiment, except that the reinforcing bar coupler of the fifth embodiment has a single wedge 4d. Thus, according to the fifth embodiment, the wedge 4d is fitted into the base sleeve 2d, from the end of each locking part 27 that has a larger diameter, using a hammering tool or a hydraulic tool, thus allowing the first and second deformed bars 1 and 1a to be firmly coupled to each other.

FIGS.31 through 35 show a reinforcing bar coupler according to the sixth embodiment of the present invention. The general construction and elements of the sixth embodiment are equal to the fifth embodiment, except that each of a base sleeve 2e and a wedge 4e are manufactured to have a constant thickness

by plastically deforming a steel plate of a predetermined thickness using a pressing machine. Thus, the entire portion of the wedge 2e has a constant thickness. A plurality of semi-annular grooves 26 are formed along the wedge 2e by a press mold, and a plurality of semicircular projecting parts are formed on an outer surface of the base sleeve 2e at positions corresponding to the semi-annular grooves 26 so as to serve as the semi-annular ribs 22. Further, the wedge 4e is manufactured by plastically deforming a steel plate using a pressing machine so that the thickness of middle section 47 is equal to the thickness of each of the locking parts 45. In order to prevent the wedge 4e from being undesirably removed from an inserted position between a cover sleeve 3e and the locking parts 27 of the base sleeve 2e, a serrated surface 43a is formed on a flat surface 43. Alternatively, each of the locking parts 27 of the base sleeve 2e that contact the leading end 41 of the wedge 4e is formed to have a width which is slightly smaller than a width of each of the locking parts 45 of the wedge 4e, so that the locking parts 27 of the base sleeve 2e are securely locked to the locking parts 45 of the wedge 4e. As shown in FIG. 32, a hammering end 42 of the middle section 47 of the wedge 4e projects away from the flat surface 43 of the wedge 4e, thus forming a V-shaped projecting part. Such a projecting part allows the hammering area of the wedge 4e to be increased, thus allowing the wedge 4e to be easily hammered. Further, a steel plate of a constant thickness is cut to have a trapezoidal shape, and then is upwardly bent at both side edges thereof with a pressing machine to form the locking parts 45 of the wedge 4e. A slanted surface 46 is formed along each of the locking parts 45 in such a way that a height of the

slanted surface 46 is tapered from a first end to a second end of each of the locking parts 45.

As shown in FIG. 33, a V-shaped groove 44 is axially formed along the middle section 47 of the wedge 4e, so as to reduce the surface area in contact with the cover sleeve 3e.

The bar coupling method using the reinforcing bar coupler according to the sixth embodiment is equal to that of the fifth embodiment.

Further, a scale rule 48 is provided on an outer surface of the middle section 47 of the wedge 4, 4a, 4b, 4c, 4d, 4e extending from the hammering end 42 to a predetermined position. Thus, when reinforcing bars of the same standard which are produced by the same manufacturing company are coupled to each other, the scale rule 48 allows the wedge 4, 4a, 4b, 4c, 4d, 4e to be inserted to a predetermined position in the base sleeve 2, 2a, 2b, 2c, 2d, 2e. The subsequent coupling operation is carried out so that the wedge 4, 4a, 4b, 4c, 4d, 4e is inserted to a predetermined position in the base sleeve 2, 2a, 2b, 2c, 2d, 2e using the scale rule 48. Thus, the scale rule 48 allows uniformly coupled reinforcing bars to be obtained, in addition to ensuring an easy post-inspection.

The elements of the reinforcing bar coupler according to the present invention may be selected out of cast steel, cast iron, steel sheet, high-strength plastic, a special alloy, etc. considering suitability, manufacturing costs, and other issues. Further, the elements may be processed through several methods including casting, forging, press process, and injection molding, considering the material chosen and workability.